

An Oligocene Record of a Flatfish from the Kiwado Formation, Yamaguchi Prefecture, Japan

Kazuo Sakamoto¹ and Teruya Uyeno²

¹Department of Zoology, University Museum, University of Tokyo,
7-3-1 Hongo, Bunkyo-ku, Tokyo, 113 Japan

²Department of Geology, National Science Museum,
3-23-1 Hyakunin-cho, Shinjuku-ku, Tokyo, 169 Japan

Abstract A fossil flatfish was found in the Oligocene Kiwado Formation, Hioki Group, Yamaguchi Prefecture, Japan. It represents the second record of the pleuronectiform fishes from the Oligocene sediments in Japan, and is identified as belonging to the subfamily Pleuronectinae of the family Pleuronectidae.

Key words: Oligocene, Kiwado Formation, flatfish, Pleuronectiformes, Pleuronectinae.

Introduction

A fossil fish was collected by Mr. Eiji Doi in the rock belonging to the early Late Oligocene Kiwado Formation of the Hioki Group (Okamoto, 1987) at a quarry of Yamane-Tekko Co. Ltd., Ouchiyama, Heki-cho, Otsu-gun, Yamaguchi Prefecture, Japan (Fig. 1). On the basis of the shape of the urohyal, the development of the first proximal pterygiophore of the anal fin and other characters, it was identified as a member of the flatfish order Pleuronectiformes, belonging to the subfamily Pleuronectinae of the family Pleuronectidae sensu Sakamoto (1984). The present fossil specimen represents the second record of the flatfishes from the Oligocene beds in Japan, following the poorly preserved one which was discovered from the lower part of the Early Oligocene Poronai Formation at Oyubari of Hokkaido (Inoue & Uyeno, 1968). The purpose of the present study is to describe this fossil specimen for confirmation of the distribution of the flatfishes around Japan in the Oligocene.

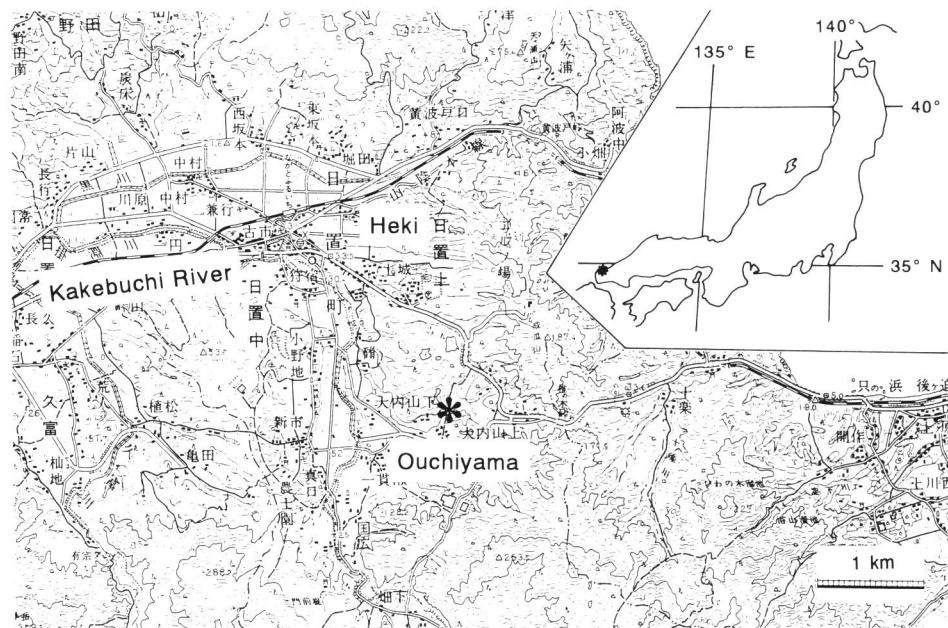


Fig. 1. Map showing the fossil locality of the Oligocene flatfish (from 1:50,000 map of "Senzaki," published by the Geographical Survey Institute of Japan).

Systematic Description

Class Osteichthyes Huxley, 1880

Order Pleuronectiformes Bleeker, 1859

Family Pleuronectidae Rafinesque, 1810

Subfamily Pleuronectinae sensu Sakamoto, 1984

Gen. et sp. indet.

(Figs. 2–8)

Material: MMHF (Mine City Museum of History and Folklore) 8-00026. The total length of the fossil is about 60 mm.

Description: The specimen is not complete, and lacks its anterior and posterior parts. It is composed of two pieces including its counterpart.

The anterior part of the head region is lacking. The posterior portion of the cranium is incompletely preserved. It is not determinable whether this specimen is left- or right-eyed. Unidentifiable fragments of the bones are sparsely remained under the cranium.

In the suspensorial and opercular regions, some fragments are observable. Of the hyoid arch, the branchiostegal rays are fragmentally preserved, and



Fig. 2. The flatfish (MMHF 8-00026) from the Oligocene Kiwado Formation, Yamaguchi Prefecture, Japan. Scale indicates 5 mm.



Fig. 3. The counterpart of Fig. 2 of the Oligocene flatfish. Scale indicates 5 mm.



Fig. 4. Anterior portion of the Oligocene flatfish (MMHF 8-00026).

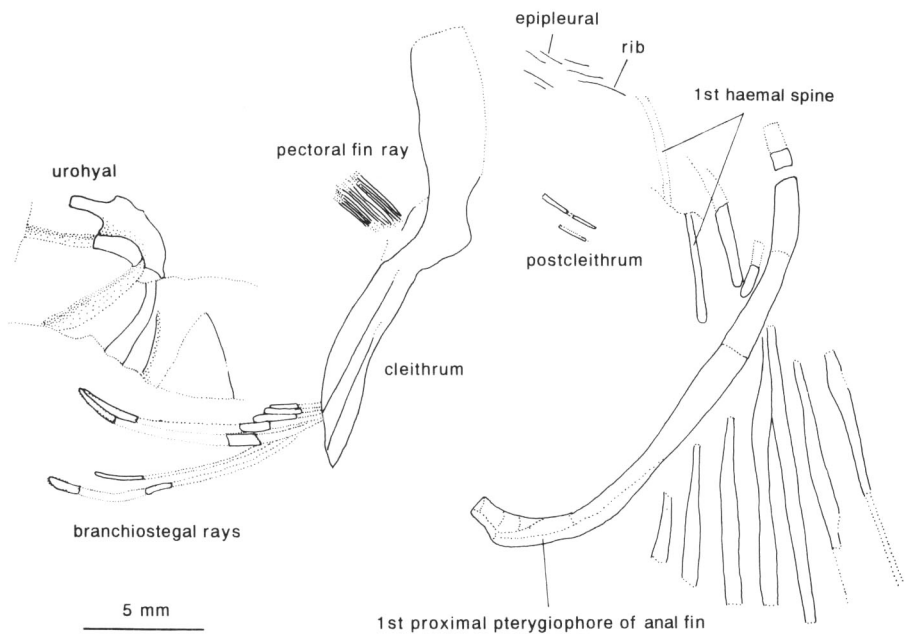


Fig. 5. Anteroventral part of the Oligocene flatfish (MMHF 8-00026).

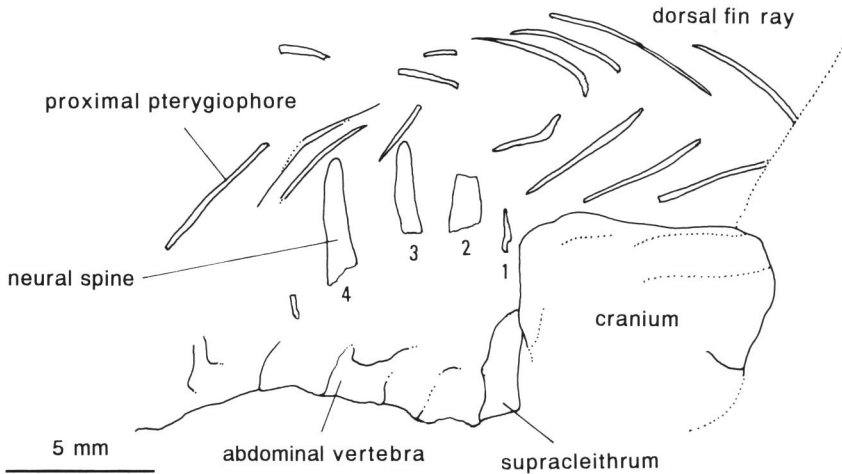


Fig. 6. Anterodorsal part of the Oligocene flatfish (MMHF 8-00026).

counted as seven. The urohyal which is fish-hook like in shape is located well before the cleithrum. The angle between the main and sciatic parts is about 40 degree (Figs. 4–5, 8).

The dorsal fin rays are incompletely preserved, and about 60 rays and about 50 proximal pterygiophores are countable (the total numbers can not be estimated). In the anal fin, no rays are remained, but about 30 incomplete pterygiophores are countable (the total can not be estimated). The first proximal pterygiophore is enlarged and robust, and dislocated in position (Figs. 4–5).

Of the shoulder girdle, the supracleithrum and cleithrum are well preserved (Figs. 4–5). The pectoral fin rays are incompletely remained, and seven rays are countable (the total is not estimated). The rays are not in natural position, and located just in front of the cleithrum. Two fragments of the postcleithrum are preserved (Fig. 5).

The abdominal vertebrae with neural spines are preserved, and counted as approximately 12. The anterior four neural spines are well developed, but incompletely remained. The second to fourth ones are plate-like in shape (Fig. 6). Some fragments of the ribs and epipleurals are sparsely remained (Fig. 5). Other intermuscular bones are not observed. The caudal vertebrae with well developed neural and haemal spines are preserved, and counted as approximately 24.

The caudal skeletons are very poorly preserved, and lacks its lower portion. Some elements are recognized from their traces. The neural spine of the second preural centrum is observable. The epural is observed between the neural spine of the second preural centrum and the fifth hypural. In the hypurals, the fourth one is at least fused with other hypurals. The fifth hypural is independently present (Fig. 7). No rays are remained.

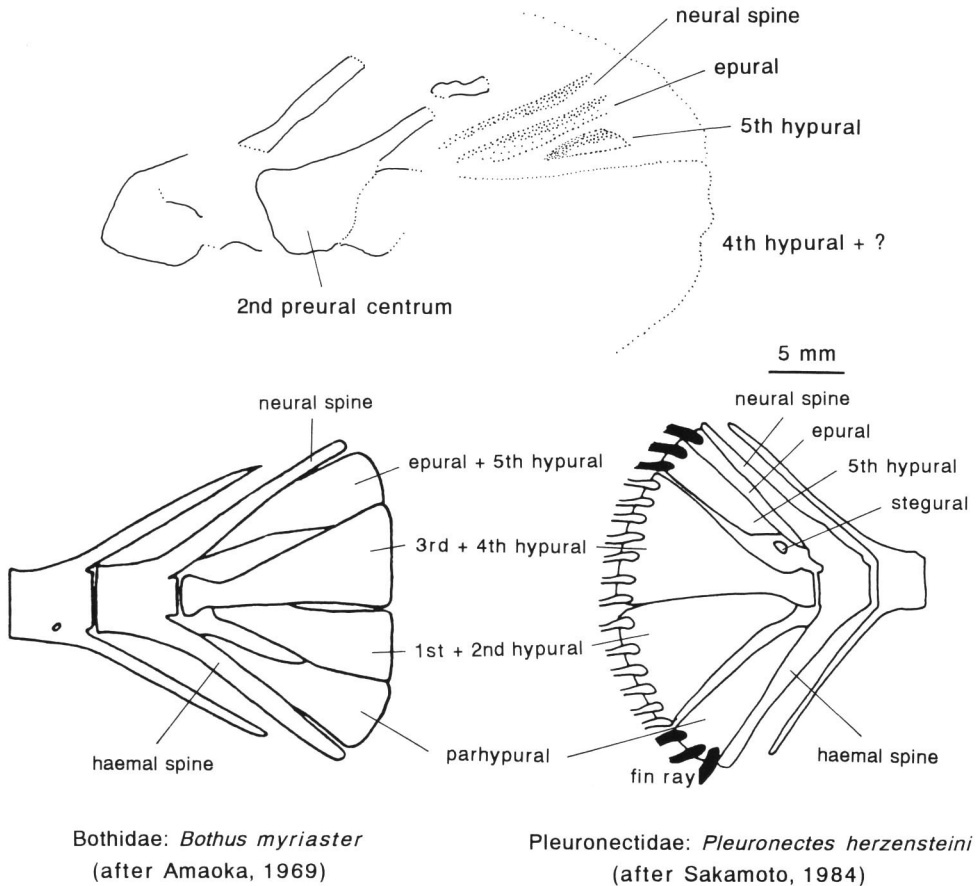


Fig. 7. Caudal skeletons in the Oligocene flatfish (MMHF 8-00026) and two flatfishes.

Discussion

It is no doubt that the present fossil fish is included in the order Pleuronectiformes in having the fish-hook like urohyal and the enlarged first proximal pterygiophore of the anal fin (Norman, 1934; Hubbs, 1945; Ochiai, 1966; Amaoka, 1969, 1972; Hensley & Ahlstrom, 1984). Also, it belongs to the Paralicthyidae sensu Amaoka (1969) or the Pleuronectidae sensu Sakamoto (1984) because of possession of several characters in addition to the two characters mentioned above. They are as follows: the postcleithrum is present, ribs and epipleurals are present, a free epural is present, the fourth hypural is at least fused with other hypurals, and the fifth hypural is separated with other hypurals (Figs. 5, 7) (Amaoka, 1969, 1972; Hensley & Ahlstrom, 1984; Sakamoto, 1984).

Although it is not possible to judge by the characters mentioned above

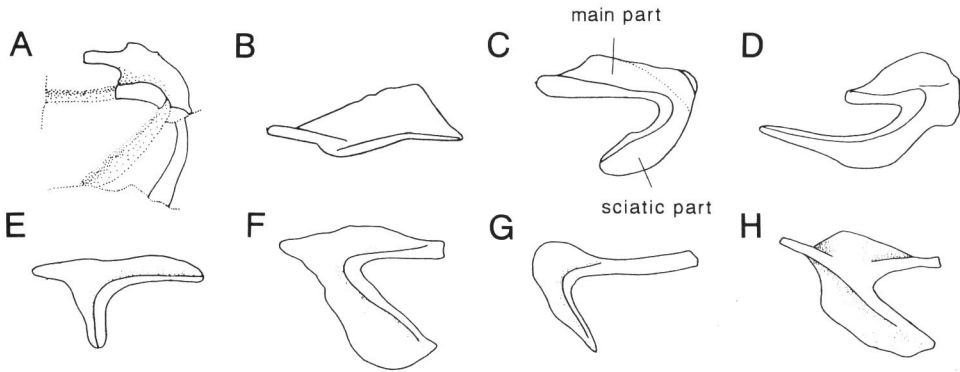


Fig. 8. Lateral aspects of urohyals in the Oligocene flatfish (MMHF 8-00026) and seven flatfishes. A, the Oligocene flatfish (MMHF 8-00026); B, *Psettodes erumei* (Psettodidae); C, *Paralichthys olivaceus* (Paralichthyidae); D, *Bothus myriaster* (Bothidae); E, *Reinhardtius hippoglossoides* (Pleuronectidae, Pleuronectinae); F, *Pleuronectes herzensteini* (Pleuronectidae, Pleuronectinae); G, *Poecilopsetta plinthus* (Pleuronectidae, Poecilopsettinae); H, *Plagiopsetta glossa* (Pleuronectidae, Samarinae). B–D, after Amaoka (1969); E–H, after Sakamoto (1984). Familial and subfamilial classifications follow Amaoka (1969) and Sakamoto (1984).

whether the fossil flatfish belongs in the Paralichthyidae or the Pleuronectidae, we assigned it to the Pleuronectidae, comparing it with skeletal elements of Recent species of the two families around Japan. The fossil flatfish is most similar to *Paralichthys olivaceus* among species of the Paralichthyidae, but differs from it in the number of abdominal vertebrae (approximately 12 vs. 11 in *P. olivaceus*, data from Amaoka, 1969). Among four subfamilies within the Pleuronectidae (Sakamoto, 1984), it belongs to the Pleuronectinae in having a well developed first neural spine (Sakamoto, 1984). Moreover, the urohyal in this flatfish appears to resemble most members of the Pleuronectinae (Fig. 8). It is, however, difficult to be identified down to the genus level. On the basis of these considerations, the present flatfish is assigned to the subfamily Pleuronectinae sensu Sakamoto (1984).

Although flatfish fossils have been found in various deposits from the Oligocene to the Pleistocene at several localities in Japan, most of them were discovered from the Miocene sediments (Sakamoto & Uyeno, 1989; Yabumoto & Uyeno, 1994; Ohe & Kawase, 1995). Of the Oligocene flatfishes, there has been an only record from the Poronai Formation at Oyubari, Hokkaido by Inoue & Uyeno (1968). Although the Oyubari fossil flatfish was quite incomplete and consisted only of 14 caudal vertebrae, 19 proximal pterygiophores of the anal fin and four of the dorsal fin, and few scattered pieces of the anal rays, it was safely placed in the Pleuronectiformes in having the following characters: the consistent presence of two (proximal) pterygiophores of the dorsal and anal rays between

two adjacent haemal or neural spines, and a great body depth (Inoue & Uyeno, 1968). On the other hand, this fossil flatfish is rather well preserved compared to the Oyubari one, being more easily identified as a member of the flatfishes as discussed above.

As a result of the work by Inoue & Uyeno (1968) and the present study, it was confirmed that flatfishes had been distributed around Japan at least in the Oligocene.

According to Patterson (1993), the oldest record of the flatfish order Pleuronectiformes is from the Early Eocene.

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